

Mathematics of Flight

Distance, Rate and Time



Distance, Rate and Time

In flight applications, distance is usually measured in miles.

Rate or speed is usually measured in knots (nautical miles per hour.)

Time is usually measured in hours.

Distance, Rate and Time

The distance formula is:

Distance = rate x time

or

$$d = rt$$

Distance, Rate and Time

It can also be used to calculate speed of an aircraft when distance and time are given, or to find the time when the distance and speed are given.

Distance, Rate and Time

The Mustang was among the best and most well-known fighters used by the U.S. Army Air Forces during World War II. Possessing excellent range and maneuverability, the P-51 operated primarily as a long-range escort fighter and also as a ground attack fighter-bomber. The Mustang served in nearly every combat zone during WWII, and later fought in the Korean War



Maximum speed: 437 mph
Cruising speed: 275 mph
Range: 1,000 miles

Distance, Rate and Time

Exercise 1

The P-51 aircraft travels at a cruising speed of 275 knots and has a range (maximum distance) of 1,000 miles. Can it fly for three hours before running out of fuel? Can it fly for 4 hours before running out of fuel?

Distance, Rate and Time

Exercise 1

The P-51 aircraft travels at a cruising speed of 275 knots and has a range (maximum distance) of 1,000 miles. Can it fly for three hours before running out of fuel? Can it fly for 4 hours before running out of fuel?

Solution:

$$d = r t$$

$$d = 275 \text{ knots} \times 3 \text{ hours}$$

$$d = 825 \text{ nautical miles}$$

yes, it is within the range of 1,000 nautical miles

$$d = r t$$

$$d = 275 \text{ knots} \times 4 \text{ hours}$$

$$d = 1,100 \text{ nautical miles}$$

no, it can not fly for four hours if its range is 1,000 nautical miles

Distance, Rate and Time

The Shooting Star was the first American aircraft to exceed 500 mph in level flight, the first American jet airplane manufactured in large quantities and the first U.S. Air Force jet used in combat.

Although designed as a high-altitude interceptor, the F-80C was flown as a day fighter, fighter-bomber and photo reconnaissance aircraft during the Korean War. On Nov. 8, 1950, an F-80C flown by 1st Lt. Russell J. Brown shot down a Russian-built MiG-15 in the world's first all-jet fighter air battle.



Maximum speed: 580 mph

Cruising speed: 437 mph

Range: 1,090 miles

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Exercise 2

The F-80C has a cruising speed of 437 knots and a range of 1,090 nautical miles. How many hours can it fly before running out of fuel?

Distance, Rate and Time

Exercise 2

The F-80C has a cruising speed of 437 knots and a range of 1,090 nautical miles. How many hours can it fly before running out of fuel?

Solution:

$$d = r \ t$$

$$\frac{d}{r} = \frac{r}{r} \ t \qquad \frac{1,090}{437} = \frac{437}{437} \times \text{time}$$

$$\frac{d}{r} = t \qquad \frac{1,090}{437} = \text{time}$$

$$2.49 \text{ hours} = \text{time}$$

Distance, Rate and Time

The A-10 is the first U.S. Air Force aircraft designed specifically for close air support of ground forces. It is very maneuverable at low speeds and low altitudes to ensure accurate weapons delivery, and it carries the systems and armor needed to survive in this environment. It is intended for use against all ground targets, but specifically tanks and other armored vehicles.



Maximum speed: 450 nautical mph
Range: 800 miles

Distance, Rate and Time

Exercise 3

The A-10 has a range of 800 miles and a maximum speed of 450 knots. If it flew at its maximum speed throughout the flight, how many hours can it fly before running out of fuel? What is the answer in minutes?

Distance, Rate and Time

Exercise 3

The A-10 has a range of 800 miles and a maximum speed of 450 knots. If it flew at its maximum speed throughout the flight, how many hours can it fly before running out of fuel? What is the answer in minutes?

Solution:

$$d = r t$$

$$\frac{d}{r} = \frac{r}{r} t \quad \frac{800}{450} = \frac{450}{450} \times \text{time}$$

$$\frac{d}{r} = t \quad \frac{800}{450} = \text{time}$$

$$1.7 \text{ hours} = \text{time}$$

(To convert hours to minutes, multiply by 60)

$$1.7 \text{ hours} \times 60 \text{ minutes/hour} = 106.6 \text{ minutes}$$

Distance, Rate and Time

The Lockheed F-117A was developed in response to an Air Force request for an aircraft capable of attacking high value targets without being detected by enemy radar. By the 1970s, new materials and techniques allowed engineers to design an aircraft with radar-evading or "stealth" qualities. The result was the F-117A, the world's first operational stealth aircraft.



Maximum cruise speed: 684 mph
Range: Unlimited with aerial refueling

Distance, Rate and Time

Exercise 4

The F-117A has a maximum cruising speed of 684 knots. Its range is unlimited due to air-to-air refueling. If it flew for three hours, how far did it fly?

Distance, Rate and Time

Exercise 4

The F-117A has a maximum cruising speed of 684 knots. Its range is unlimited due to air-to-air refueling. If it flew for three hours, how far did it fly?

Solution:

$$d = r t$$

$$d = 684 \text{ knots} \times 3 \text{ hours}$$

$$d = 2,052 \text{ nautical miles}$$

More Resources

**Additional Resources
are available online at**

www.nationalmuseum.af.mil/education/teacher/index.asp